AIRPORT PAVEMENT MANAGEMENT: ENHANCEMENTS TO MICRO PAVER

By:

M. Y. Shahin, Ph.D., P.E.
US Army Corps of Engineers, ERDC
2902 Farber Drive, Champaign, Illinois 61822
217.373.4466 phone, 217.373.3490 fax
Mohamed.Y.Shahin@erdc.usace.army.mil

Kurt A. Keifer, E.I.T
US Army Corps of Engineers, ERDC
2902 Farber Drive, Champaign, Illinois 61822
217.373.4463 phone, 217.373.3490 fax
Kurt.Keifer@erdc.usace.army.mil

Jeffrey A. Burkhalter
US Army Corps of Engineers, ERDC
2902 Farber Drive, Champaign, Illinois 61822
217.373.4464 phone, 217.373.3490 fax
Jeffrey.A.Burkhalter@erdc.usace.army.mil

PRESENTED FOR THE 2002 FEDERAL AVIATION ADMINISTRATION AIRPORT TECHNOLOGY TRANSFER CONFERENCE

05/02

Abstract

Micro PAVER is developed by the US Army Corps of Engineers, Engineer Research and Development Center (USACE ERDC) through funding provided by the US Air Force, US Army, US Navy, Federal Aviation Administration, and Federal Highway Administration. The enhancements made to Micro PAVER will improve the ability of airport agencies to manage their pavements. User interface modifications as well as improvements to the analysis capabilities of the software will improve the efficiency of both daily users and decision makers, respectively. The incorporation of internal GIS-based inventory selection and reporting tools give Micro PAVER an enhanced visual component, while the ability to create PCI-based and other distresses greatly improve the flexibility of the software. Enhanced reporting capabilities make extracting data from the system easier and iterative work planning routines make budget analysis less time consuming.

Introduction

Micro PAVER is currently used as the airport pavement management system for commercial airports worldwide – from O'Hare International Airport in Chicago to Inchon International Airport in South Korea. Many states use Micro PAVER to manage their general aviation airports – Arizona, California, Colorado, Georgia, Illinois, Maryland, Ohio, Pennsylvania and South Carolina. Furthermore, the US Air Force, US Army and the US Navy use Micro PAVER to manage their airfield pavements.

In response to user demand and sponsor funding, Micro PAVER version 5.0 has been released with the following modifications: a much improved user interface; enhanced reporting capabilities; the ability to store additional inventory and condition data; the ability to define new condition indexes (which may or may not be based on Pavement Condition Index (PCI) distresses); the ability to run work plans based on desired end-condition (as opposed to simply a constrained annual budget); and the ability to view geographical information system (GIS) data within Micro PAVER.

Future versions of the software will contain additional work planning analysis capabilities beyond those of versions 5.0. In addition to the 5.0 improvements, future versions will provide users with the ability to: account for the affect of preventive maintenance on pavement performance when developing work plans; assign both multiple work models and multiple cost tables when developing work plans; formulate projects either before or after running work plans; and base work planning decisions on multiple condition indexes.

Enhancements to Micro PAVER for Improved Airport Pavement Management

Airport Pavement Inventory

Airport pavement inventories are commonly broken into "networks", "branches" and "sections". A network is a group of pavements that are managed together – typically as a budget line item. For example, state aviation agencies manage multiple general aviation (GA) airports. Consequently, each GA airport is defined as a separate network within the state's pavement

management database. Commercial and military airports often break airside and landside pavements into separate networks. A branch is an area of pavement that shares a common use. For example, a specific runway may be defined as a branch. A section is defined as a pavement area within a branch that shares similar structural characteristics and loading conditions. Equally as important, however, is that a section is considered a management unit – meaning that condition analysis and work planning is performed at the section level and then rolled-up to the branch and network levels. There is often a one to one relationship between facilities and sections at GA airports. Commercial and military airports typically have multiple sections within a branch due primarily to the size of the facilities and the growth that occurs at larger airports which results in section extensions and structural improvements.

Micro PAVER users have requested the ability to add "user-defined-fields" at the network, branch, and section levels of the hierarchy in order to further subdivide their pavement network. This capability has been added to Micro PAVER 5.0. For example, a state aviation department may wish to store the county that an airport is in along with the latitude and longitude of that airport at the network level and to store data on funding sources for pavement work at the section level.

Additionally, new branch uses and pavement surface types may be defined. New branch uses must be assigned as either airside or landside, and new surface types must be defined as either asphalt or concrete. These definitions are necessary for determining which PCI standard and set of distresses is to be used with the new surface type.

Furthermore, Micro PAVER 5.0 allows users to easily move and copy inventory, condition and historical work data. Micro PAVER users are often required to adjust the organization of their inventory. For example, reconstructing a portion of a runway may require splitting a pavement section. A tool has been added in Micro PAVER 5.0 that enables users to easily move and copy inventory data. Examples of where this tool may come in handy include the following: moving sample units from one section to another, which is useful when subdividing or combining sections; copying a work item such as a surface treatment to multiple sections at the same time; and consolidating several facilities into one.

Users are also able to manage their data more efficiently through an improved user interface. The selection of inventory items may be done through "selection tools" which consist of a "floating" inventory selection tool along with tree and internal GIS selection tools. Modules now react in unison to user selections. For example, when the "floating" inventory selection tool is used to select an inventory item, that item may become active in all open modules. The tree and GIS selection tools can be used in a similar manner. For example, to view the maintenance history of an apron, the user simply opens the work history module and then clicks on the desired apron on the GIS map, thereby broadcasting to the entire program to refresh to that piece of inventory. The interface may be customized to either enable or prevent the broadcasting of selections. Refer to Figure 1.

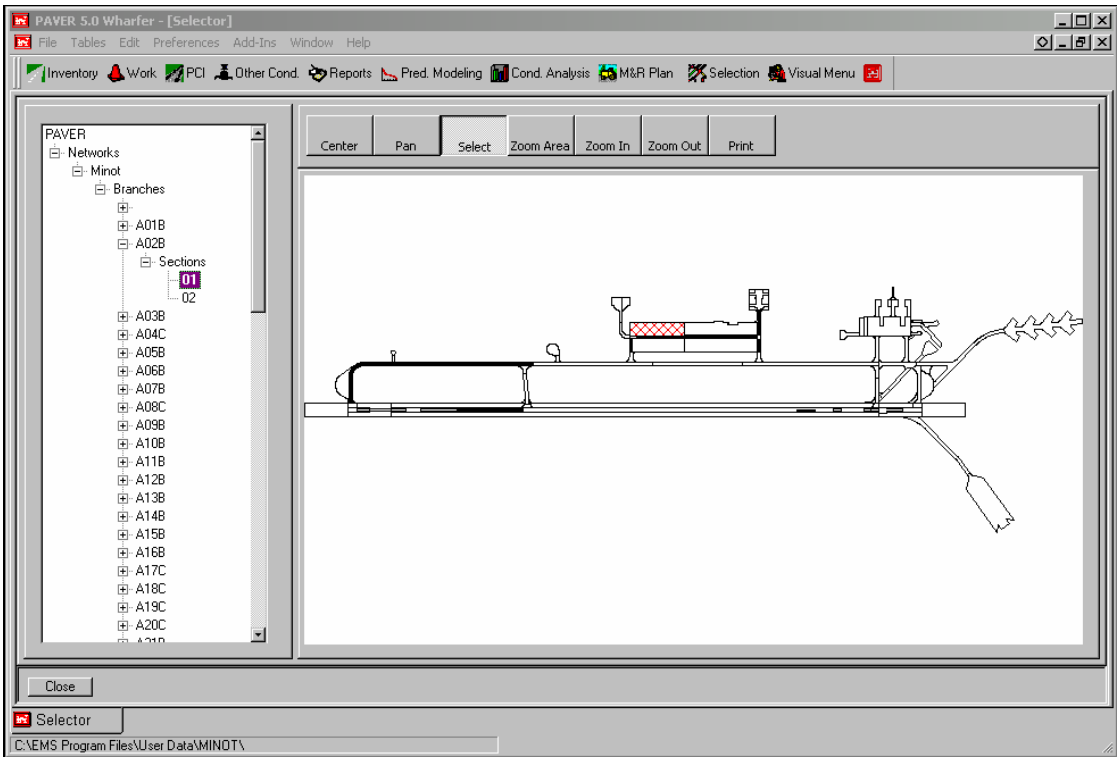

Figure 1. Improved user interface – tree and GIS "selectors".

Airport Pavement Inspection

ASTM Standard Practices D 5340, "Standard Test Method for Airport Pavement Condition Index Surveys", and D 6433, "Standard Test Method for Roads and Parking Lots Pavement Condition Index Surveys" are frequently used for performing airside and landside pavement condition inspections, respectively. Both standard practices yield the Pavement Condition Index (PCI), which is a number ranging between 0 (worst condition) to 100 (best condition). The PCI is based on a visual distress survey which takes into account various distress types, distress severity levels, and distress quantities.

At GA, commercial, and military airports, field inspection crews typically perform airside pavement PCI surveys. Landside pavement PCI surveys are often performed in the same manner – with the inspection crews either 1) entering collected data in the field on hand-held devices or 2) later entering the data into Micro PAVER from paper inspection data collection forms. Many US Air Force landside pavements are inspected using automated collection methods (e.g., vehicles that take a continuous image of the pavement surface). However, interpretation of the collected images must be performed manually.

In order to facilitate the entry of PCI distress data collected using automated collection methods, Micro PAVER 5.0 has included a feature that enables such data to be easily imported. To accommodate this technology, Micro PAVER 5.0 provides a new batch import interface that supports PCI inspection and other condition data. The PCI inspection data is supported in either

the traditional sample format, or a frame format that is better suited to automated data collection methods.

Condition Indexes

Micro PAVER 5.0 allows for the creation of user-defined condition based on the same distresses and calculation algorithms as those used by the PCI. Users may create a new index, and choose the PCI-based distresses and severity levels to be associated with the index. The new index calculates a value using the same method as the PCI, but is generated with the existing inspection data from a PCI inspection. In addition to PCI-based indexes, other indexes may be created. For example, users may track the quality of pavement markings, through either a numeric or textual index. Refer to Figure 2.

Airport Pavement Performance Modeling and Condition Analysis

Micro PAVER uses the PCI-based "family modeling" method[1] for evaluating pavement performance. Family models are developed by grouping the inspection data – which consist of pavement age and PCI at the time of inspection – of similar pavements (e.g., similar structure, loading, environmental conditions, etc.) together to generate deterioration curves. Pavement sections are assigned a family model that is then used to predict the future condition of that section. Condition predictions are then used to determine when work should be performed on pavement sections. Micro PAVER is currently limited to PCI-based family modeling only. However, future versions of the software will enable family modeling based on other condition indexes.

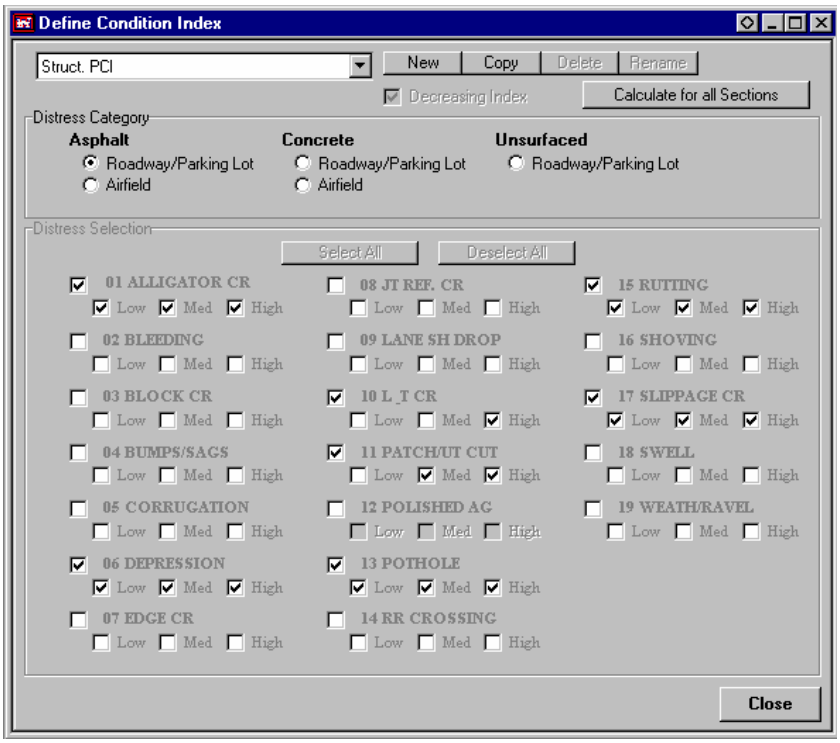

Figure 2. PCI-based condition indexes.

Airport Pavement Work Planning

Beyond simply storing inventory and condition data, a more useful capability of an airport pavement management system is determining when, where, and what type of work is required for budget planning purposes. Work planning can be categorized as either network or project. Network work planning is concerned with "work levels" (e.g., preventive, global, and major work) while project work planning is concerned with "work types" (e.g., 4" versus 6" overlay, various mix designs, etc.). Work planning within Micro PAVER is performed primarily at the network level and is based on the "Critical PCI" method[1].

When planning pavement maintenance and repair, it is beneficial to examine several scenarios based on different budgets and condition goals. In the past, Micro PAVER work planning was used for determining budget consequences – which is reasonable when budgets are known. However, airport managers are often expected to assess their pavement work requirements and apply for the necessary funding.

In response to this need, Micro PAVER 5.0 has been modified to determine budget requirements. There are three variants of this process to address different demands. First, managers often have a target average condition for a group of pavements – a target condition that typically exceeds their current average condition. Micro PAVER 5.0 allows users to set a desired end-condition value and then perform an analysis to determine what work needs to be done to reach the target. Second, managers may use this tool to determine the work requirements for sustaining the current condition of a group of pavements or the entire network. This is a "maintain the status quo" scenario. Lastly, managers may determine the budget needed to eliminate the major work backlog over a specified period of time. These work planning options use an iterative process of Micro PAVER's traditional work planning functions. Refer to Figure 3.

Future versions of Micro PAVER (beyond 5.0) will take into account the benefit of performing preventive maintenance. Users will be able to enter the expected increase in pavement life by performing regular preventive maintenance. Users will also be able to create and assign work models and assign them to pavement sections, and work plans will be able to be developed based on condition indexes other than the PCI. Project formulation and prioritization capabilities will also be added to future versions of Micro PAVER.

Reporting

Micro PAVER is currently capable of generating many reports ranging from section condition reports to PCI re-inspection reports. In spite of the number of reports currently available in Micro PAVER, users have requested a more flexible method for reporting that gives them the ability to create custom reports. Micro PAVER 5.0 provides a flexible reporting tool. This tool enables users to generate reports that include only the data they want to see. In addition, the report provides access to most stored data and adds some basic queries to aid in report creation. Customized report formats can be saved for later use. In addition to the flexible reporting tool, there are standard GIS reports available. The GIS reports display condition information from the last inspection and some basic inventory information about the pavement network. The GIS

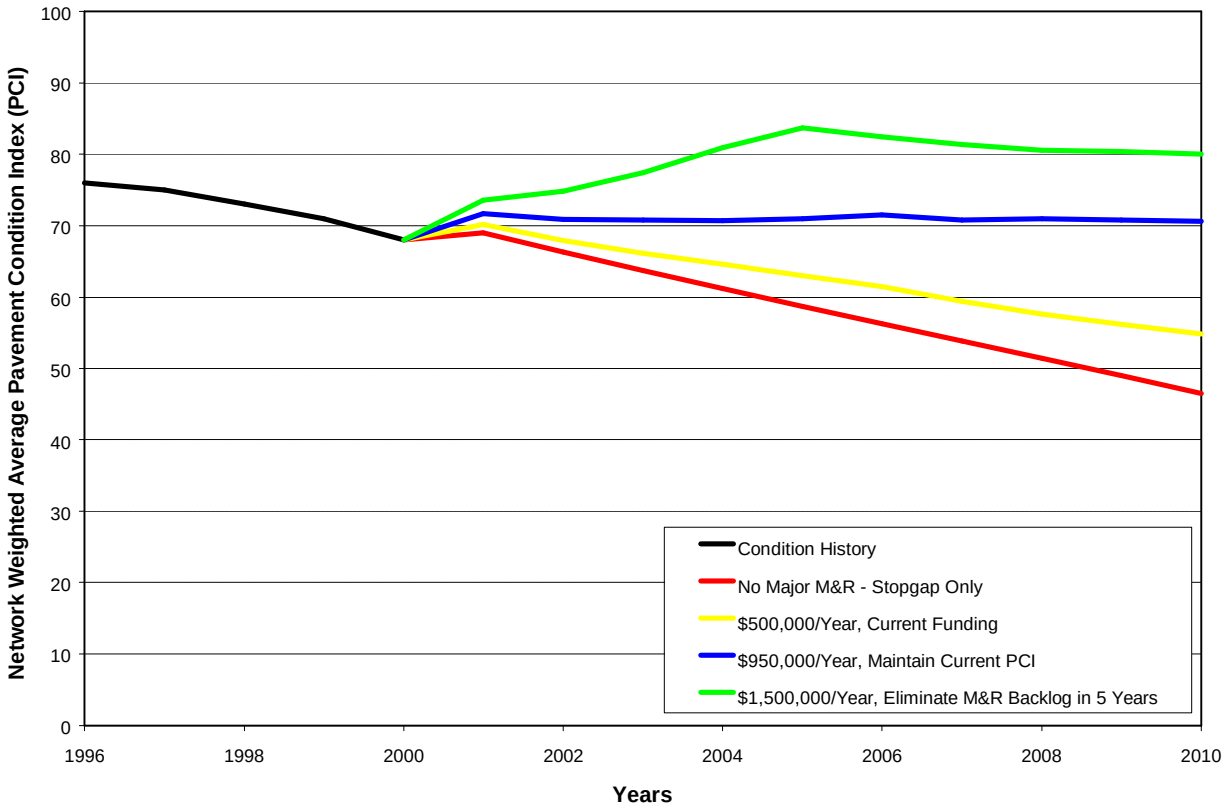

Figure 3. Maintain current condition and backlog elimination iterative work planning scenarios.

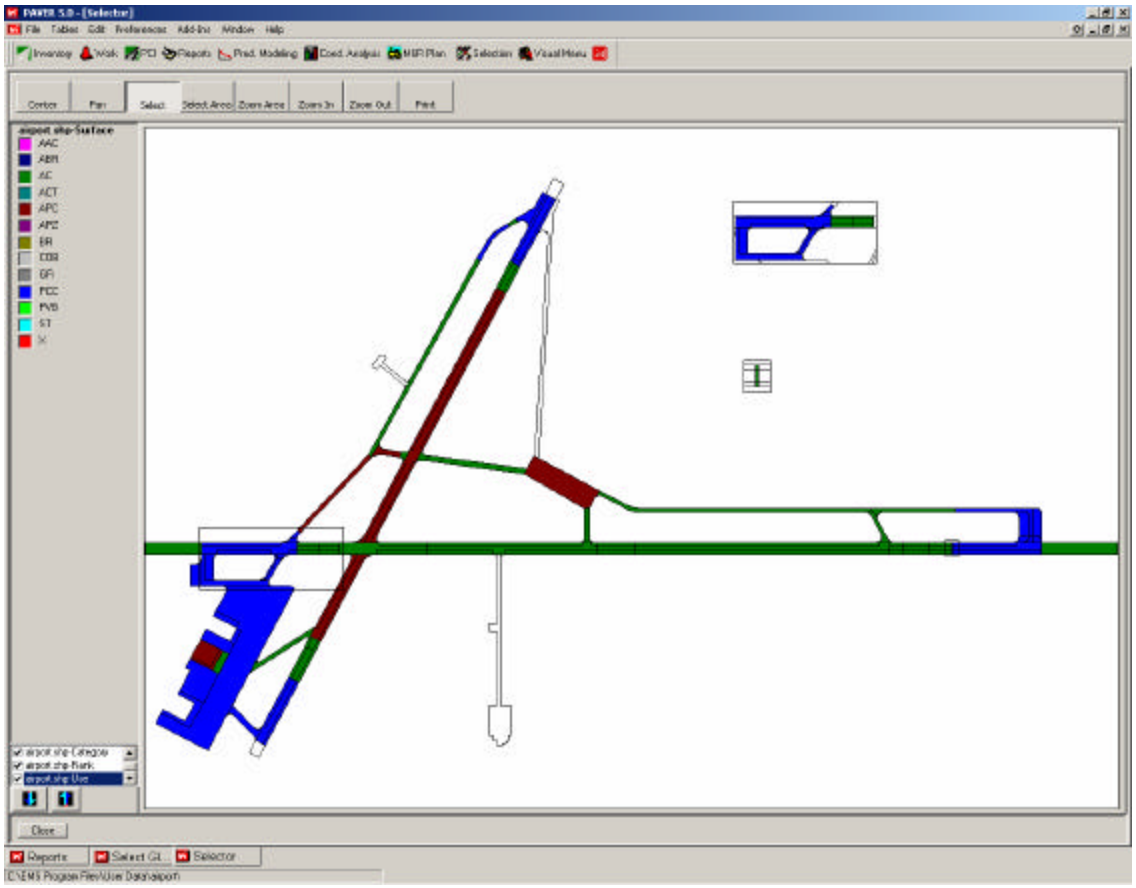

Figure 4. Internal GIS reporting.

report format is also used for the outputs of condition analysis and work planning. Refer to Figure 4.

Conclusions

The enhancements made to Micro PAVER will improve the ability of airport agencies to manage their pavements. Modifications made to the user interface of the software will improve the efficiency of the day-to-day user while decision makers will welcome the improvements to the analysis capabilities. The incorporation of internal GIS-based inventory selection and reporting tools give Micro PAVER a more appealing visual component, while the ability to create PCI-based and other distresses greatly enhance the flexibility of the software. Enhanced reporting capabilities make extracting data from the system easier and iterative work planning routines make budget analysis less time consuming. The input from Micro PAVER users continues to be the driving force behind Micro PAVER's evolution.

Reference

1. Shahin, M. Y., J. A. Walther. "Pavement Maintenance Management for Roads and Streets Using the PAVER System." USACERL Technical Report M-90/05, July 1990.